

**PCT**

**NOTICE INFORMING THE APPLICANT OF THE  
COMMUNICATION OF THE INTERNATIONAL  
APPLICATION TO THE DESIGNATED OFFICES**

(PCT Rule 47.1(c), first sentence)

From the INTERNATIONAL BUREAU

To:

SUNDSTRÖM, Per  
Stenhagen Patentbyrå AB  
P.O. Box 4630  
S-116 91 Stockholm  
SUÈDE

**ANKOM**

**2001-05-11**

<b>Date of mailing (day/month/year)</b> 03 May 2001 (03.05.01)		<b>IMPORTANT NOTICE</b>	
<b>Applicant's or agent's file reference</b> P7853PC			
<b>International application No.</b> PCT/SE00/02101	<b>International filing date (day/month/year)</b> 27 October 2000 (27.10.00)	<b>Priority date (day/month/year)</b> 29 October 1999 (29.10.99)	
<b>Applicant</b> CURT FALK AB et al			

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:  
**AU,KP,KR,US**

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:  
**AE,AG,AL,AM,AP,AT,AZ,BA,BB,BG,BR,BY,BZ,CA,CH,CN,CR,CU,CZ,DE,DK,DM,DZ,EA,EE,EP,ES,FI,GB,GD,GE,GH,GM,HR,HU,ID,IL,IN,IS,JP,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MA,MD,MG,MK,MN,MW,MX,MZ,NO,NZ,OA,PL,PT,RO,RU,SD,SE,SG,SI,SK,SL,TJ,TM,TR,TT,TZ,UA,UG,UZ,VN,YU,**  
 The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).
3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on  
 03 May 2001 (03.05.01) under No. WO 01/31219

**REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)**

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a **demand for international preliminary examination** must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

**REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))**

If the applicant wishes to proceed with the international application in the **national phase**, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

<b>The International Bureau of WIPO</b> 34, chemin des Colombettes 1211 Geneva 20, Switzerland	<b>Authorized officer</b> <p style="text-align: center;">J. Zahra</p>
Facsimile No. (41-22) 740.14.35	Telephone No. (41-22) 338.83.38

# PATENT COOPERATION TREATY

## PCT

### NOTIFICATION CONCERNING SUBMISSION OR TRANSMITTAL OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

From the INTERNATIONAL BUREAU

To:

SUNDSTRÖM, Per ANKOM  
Stenhagen Patentbyrå AB  
P.O. Box 4630  
S-116 91 Stockholm 2001-07-02  
SUÈDE

Date of mailing (day/month/year) 22 December 2000 (22.12.00)	
Applicant's or agent's file reference P7853PC	<b>IMPORTANT NOTIFICATION</b>
International application No. PCT/SE00/02101	International filing date (day/month/year) 27 October 2000 (27.10.00)
International publication date (day/month/year) Not yet published	Priority date (day/month/year) 29 October 1999 (29.10.99)
Applicant CURT FALK AB et al	

1. The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).
2. This updates and replaces any previously issued notification concerning submission or transmittal of priority documents.
3. An asterisk(\*) appearing next to a date of receipt, in the right-hand column, denotes a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b). In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.
4. The letters "NR" appearing in the right-hand column denote a priority document which was not received by the International Bureau or which the applicant did not request the receiving Office to prepare and transmit to the International Bureau, as provided by Rule 17.1(a) or (b), respectively. In such a case, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

<u>Priority date</u>	<u>Priority application No.</u>	<u>Country or regional Office or PCT receiving Office</u>	<u>Date of receipt of priority document</u>
29 Octo 1999 (29.10.99)	9903911-7	SE	20 Dece 2000 (20.12.00)

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland  Facsimile No. (41-22) 740.14.35	Authorized officer  <div style="text-align: right;">Khemais BRAHMI</div> <div style="text-align: right;"> </div> Telephone No. (41-22) 338.83.38
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# RECORD COPY

## PCT

### REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only	
International Application No.	PCT/SE 00 / 02101
International Filing Date	27 -10- 2000
<div style="border: 1px solid black; padding: 2px; text-align: center;"> The Swedish Patent Office  PCT International Application </div>	
Name of receiving Office and "PCT International Application"	
Applicant's or agent's file reference (if desired) (12 characters maximum) P7853PC	

<b>Box No. I TITLE OF INVENTION</b>	
A torque-limiting coupling device	
<b>Box No. II APPLICANT</b>	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)	
Curt Falk AB Kråkövägen 24 SE-824 51 Hudiksvall Sweden	
<input type="checkbox"/> This person is also inventor.	
Telephone No.	
Facsimile No.	
Teleprinter No.	
State (that is, country) of nationality: Sweden	State (that is, country) of residence: Sweden
This person is applicant for the purposes of: <input type="checkbox"/> all designated States <input checked="" type="checkbox"/> all designated States except the United States of America <input type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box	
<b>Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)</b>	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)	
20/SE <u>Curt Falk</u> Kråkövägen 24 SE-824 51 Hudiksvall Sweden	
This person is: <input type="checkbox"/> applicant only <input checked="" type="checkbox"/> applicant and inventor <input type="checkbox"/> inventor only (If this check-box is marked, do not fill in below.)	
State (that is, country) of nationality: Sweden	State (that is, country) of residence: Sweden
This person is applicant for the purposes of: <input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input checked="" type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box	
<input type="checkbox"/> Further applicants and/or (further) inventors are indicated on a continuation sheet.	
<b>Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE</b>	
The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: <input checked="" type="checkbox"/> agent <input type="checkbox"/> common representative	
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)	
Sundström, Per & Nilsson, Karl STENHAGEN PATENTBYRÅ AB P.O.Box 4630 SE-116 91 Stockholm Sweden	
Telephone No. +46 8 702 08 30	
Facsimile No. +46 8 640 98 58	
Teleprinter No.	
<input type="checkbox"/> Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.	

2000-10-27

## Box No. V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) (mark the applicable check-boxes; at least one must be marked):

## Regional Patent

- ☒ AP ARIPO Patent: GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, MZ Mozambique, SD Sudan, SL Sierra Leone, SZ Swaziland, TZ United Republic of Tanzania, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ EA Eurasian Patent: AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ EP European Patent: AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ OA OAPI Patent: BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line)

National Patent (if other kind of protection or treatment desired, specify on dotted line):

- |  |  |
|--|--|
| <input checked="" type="checkbox"/> AE United Arab Emirates                  | <input checked="" type="checkbox"/> LC Saint Lucia   |
| <input checked="" type="checkbox"/> AG Antigua and Barbuda                   | <input checked="" type="checkbox"/> LK Sri Lanka   |
| <input checked="" type="checkbox"/> AL Albania                               | <input checked="" type="checkbox"/> LR Liberia   |
| <input checked="" type="checkbox"/> AM Armenia                               | <input checked="" type="checkbox"/> LS Lesotho   |
| <input checked="" type="checkbox"/> AT Austria                               | <input checked="" type="checkbox"/> LT Lithuania   |
| <input checked="" type="checkbox"/> AU Australia                             | <input checked="" type="checkbox"/> LU Luxembourg  |
| <input checked="" type="checkbox"/> AZ Azerbaijan                            | <input checked="" type="checkbox"/> LV Latvia  |
| <input checked="" type="checkbox"/> BA Bosnia and Herzegovina                | <input checked="" type="checkbox"/> MA Morocco   |
| <input checked="" type="checkbox"/> BB Barbados                              | <input checked="" type="checkbox"/> MD Republic of Moldova   |
| <input checked="" type="checkbox"/> BG Bulgaria                              | <input checked="" type="checkbox"/> MG Madagascar  |
| <input checked="" type="checkbox"/> BR Brazil                                | <input checked="" type="checkbox"/> MK The former Yugoslav Republic of Macedonia                           |
| <input checked="" type="checkbox"/> BY Belarus                               | <input checked="" type="checkbox"/> MN Mongolia  |
| <input checked="" type="checkbox"/> BZ Belize                                | <input checked="" type="checkbox"/> MW Malawi  |
| <input checked="" type="checkbox"/> CA Canada                                | <input checked="" type="checkbox"/> MX Mexico  |
| <input checked="" type="checkbox"/> CH and LI Switzerland and Liechtenstein  | <input checked="" type="checkbox"/> MZ Mozambique  |
| <input checked="" type="checkbox"/> CN China                                 | <input checked="" type="checkbox"/> NO Norway  |
| <input checked="" type="checkbox"/> CR Costa Rica                            | <input checked="" type="checkbox"/> NZ New Zealand   |
| <input checked="" type="checkbox"/> CU Cuba                                  | <input checked="" type="checkbox"/> PL Poland  |
| <input checked="" type="checkbox"/> CZ Czech Republic                        | <input checked="" type="checkbox"/> PT Portugal  |
| <input checked="" type="checkbox"/> DE Germany                               | <input checked="" type="checkbox"/> RO Romania   |
| <input checked="" type="checkbox"/> DK Denmark                               | <input checked="" type="checkbox"/> RU Russian Federation  |
| <input checked="" type="checkbox"/> DM Dominica                              | <input checked="" type="checkbox"/> SD Sudan   |
| <input checked="" type="checkbox"/> DZ Algeria                               | <input checked="" type="checkbox"/> SE Sweden  |
| <input checked="" type="checkbox"/> EE Estonia                               | <input checked="" type="checkbox"/> SG Singapore   |
| <input checked="" type="checkbox"/> ES Spain                                 | <input checked="" type="checkbox"/> SI Slovenia  |
| <input checked="" type="checkbox"/> FI Finland                               | <input checked="" type="checkbox"/> SK Slovakia  |
| <input checked="" type="checkbox"/> GB United Kingdom                        | <input checked="" type="checkbox"/> SL Sierra Leone  |
| <input checked="" type="checkbox"/> GD Grenada                               | <input checked="" type="checkbox"/> TJ Tajikistan  |
| <input checked="" type="checkbox"/> GE Georgia                               | <input checked="" type="checkbox"/> TM Turkmenistan  |
| <input checked="" type="checkbox"/> GH Ghana                                 | <input checked="" type="checkbox"/> TR Turkey  |
| <input checked="" type="checkbox"/> GM Gambia                                | <input checked="" type="checkbox"/> TT Trinidad and Tobago   |
| <input checked="" type="checkbox"/> HR Croatia                               | <input checked="" type="checkbox"/> TZ United Republic of Tanzania   |
| <input checked="" type="checkbox"/> HU Hungary                               | <input checked="" type="checkbox"/> UA Ukraine   |
| <input checked="" type="checkbox"/> ID Indonesia                             | <input checked="" type="checkbox"/> UG Uganda  |
| <input checked="" type="checkbox"/> IL Israel                                | <input checked="" type="checkbox"/> US United States of America  |
| <input checked="" type="checkbox"/> IN India                                 | <input checked="" type="checkbox"/> UZ Uzbekistan  |
| <input checked="" type="checkbox"/> IS Iceland                               | <input checked="" type="checkbox"/> VN Viet Nam  |
| <input checked="" type="checkbox"/> JP Japan                                 | <input checked="" type="checkbox"/> YU Yugoslavia  |
| <input checked="" type="checkbox"/> KE Kenya                                 | <input checked="" type="checkbox"/> ZA South Africa  |
| <input checked="" type="checkbox"/> KG Kyrgyzstan                            | <input checked="" type="checkbox"/> ZW Zimbabwe  |
| <input checked="" type="checkbox"/> KP Democratic People's Republic of Korea | Check-box reserved for designating States which have become party to the PCT after issuance of this sheet: |
| <input checked="" type="checkbox"/> KR Republic of Korea                     | <input type="checkbox"/>   |
| <input checked="" type="checkbox"/> KZ Kazakhstan                            |  |

**Precautionary Designation Statement:** In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)

2000-10-27

Box No. VI PRIORITY CLAIM		<input type="checkbox"/> Further priority claims are indicated in the Supplemental Box.		
Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:		
		national application: country	regional application: * regional Office	international application: receiving Office
item (1) 29.10.1999	9903911-7	Sweden		
item (2)				
item (3)				

☒ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office) identified above as item(s): 1

\* Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.

## Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) (if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):

ISA/ SE

Request to use results of earlier search; reference to that search (if an earlier search has been carried out by or requested from the International Searching Authority):

Date (day/month/year)

Number

Country (or regional Office)

## Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following number of sheets:

request : 3 ✓  
description (excluding sequence listing part) : 7 ✓  
claims : 2 ✓  
abstract : 1 ✓  
drawings : 1 ✓  
sequence listing part of description : \_\_\_\_\_

Total number of sheets : 14 ✓

This international application is accompanied by the item(s) marked below:

- ☒ fee calculation sheet
- ☐ separate signed power of attorney
- ☐ copy of general power of attorney; reference number, if any:
- ☐ statement explaining lack of signature
- ☒ priority document(s) identified in Box No. VI as item(s):
- ☐ translation of international application into (language):
- ☐ separate indications concerning deposited microorganism or other biological material
- ☐ nucleotide and/or amino acid sequence listing in computer readable form
- ☐ other (specify):

Figure of the drawings which should accompany the abstract: 1

Language of filing of the international application: Swedish

## Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

2000 -10- 27

  
Per Sundström

For receiving Office use only

1. Date of actual receipt of the purported international application: 27 -10- 2000	2. Drawings: <input checked="" type="checkbox"/> received: <input type="checkbox"/> not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:	
4. Date of timely receipt of the required corrections under PCT Article 11(2):	
5. International Searching Authority (if two or more are competent): ISA/SE	6. <input type="checkbox"/> Transmittal of search copy delayed until search fee is paid.

For International Bureau use only

Date of receipt of the record copy by the International Bureau:	12 DEC 2000	( 12.12.00 )
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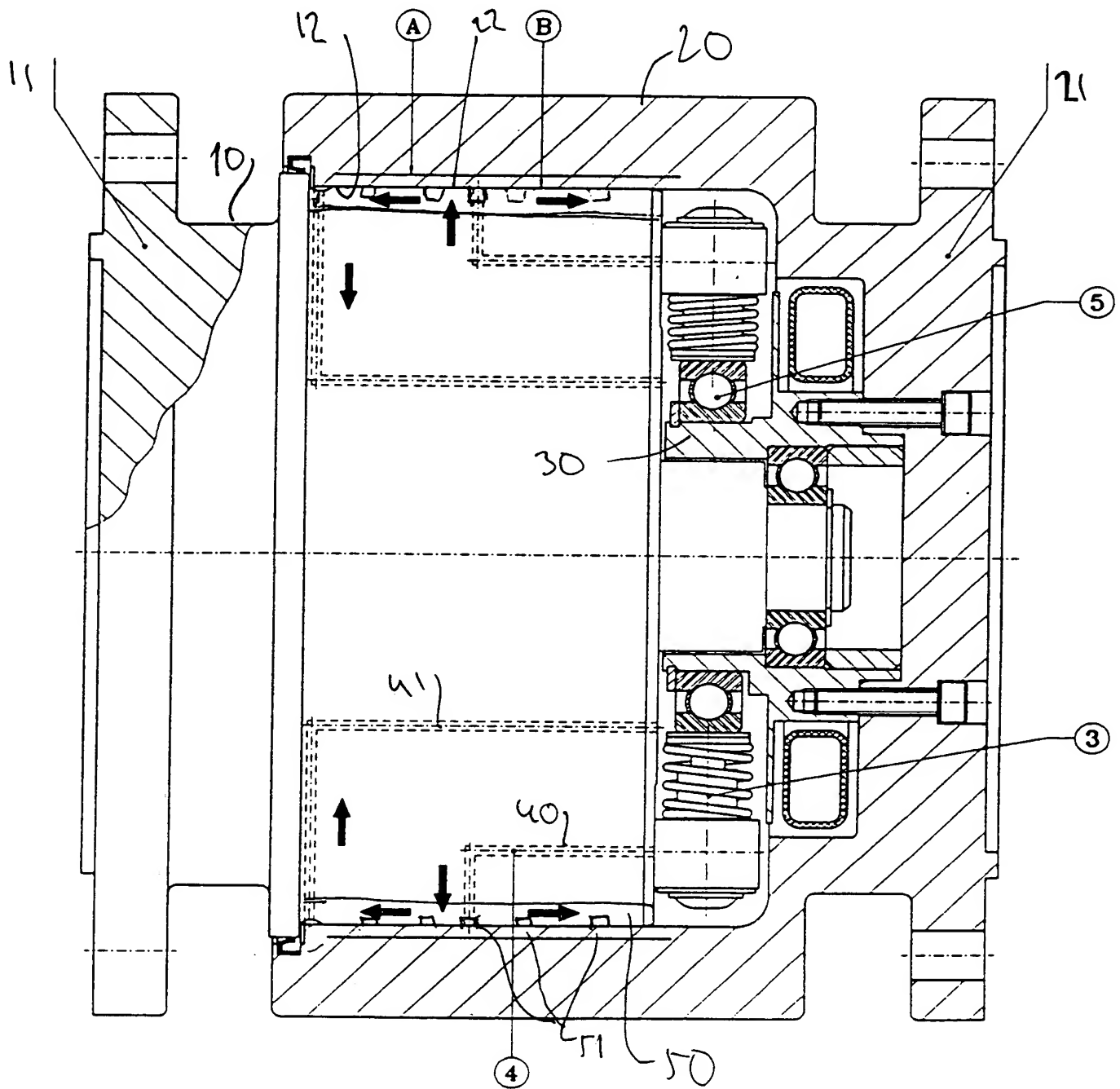


Fig 1.

**Vridmomentbegränsande kopplingsanordning**

Uppfinningen avser en vridmomentbegränsande kopplingsanordning  
5 av den art som anges i kravets 1 ingress.

En kopplingsanordning av den aktuella arten avslöjas i WO 90/  
00231. Den kända anordningen fungerar allmänt väl. Anordningar  
av denna typ användes ofta i stålvalsverk mellan en drivmotor,  
10 exempelvis en elmotor och en vals. Den överförda effekten kan  
vara exempelvis 20 000 kW. Kostnaden för stillestånd i ett så-  
dant valsverk kan ligga i storleksordningen upp till 100 000  
SEK/tim.

15 Vid aktuella användningsområden utlöses anordningen med en re-  
lativt låg frekvens, exempelvis i området från en gång vart  
femte år till 300 per år. En typisk utlösningfrekvens är 20  
gångar per år.

20 Kopplingsanordningen innefattar i grunden två axiella väsentli-  
gen cylindriska samverkansytor på två samverkande delar i for-  
men av en cylindrisk hylsa resp. ett cylindriskt skaft, varvid  
hylsan står i vridmomentöverförande friktionsingrepp med skaf-  
tet för överföring av vridmoment upp till svarande gräns, var-  
25 efter hylsan börjar glida relativt skaftet. Friktionsingreppet  
kan inställas på en valbar nivå med någon lämplig teknik. Exem-  
pelvis kan hylsan innehålla en koncentrisk ringkammare som kan  
trycksättas. I kopplingsanordningen finns en eller flera pum-  
par, som är anordnade att pumpa en vätska från förrådet till  
30 spalten mellan samverkansytorna så att vätskan tillsammans med  
samverkansytorna bildar ett hydrostatiskt lager. Pumparna är  
anordnade att drivas av en relativ rotation mellan de nämnda  
delarna. Tack vare inpumpningen av vätskan mellan samverkans-  
ytorna kan dessa glida inbördes omedelbart efter det att det  
35 inställda vridmomentet överskridits. Härigenom kan man undvika  
skador vid kopplingsanordningen och vid motorn eller valsver-  
ket. En vridmomentbegränsande kopplingsanordning av den kända  
arten behöver bara ha knappt ett rotationsvarv för att övergå

till ett hydrostatiskt lager för vilket vridmomentet reduceras till nära noll-nivå.

5 Efter utlösning måste drivningen helt stoppas. Därefter slutar kopplingsanordningens pumpar att pumpa in vätska (olja) mellan samverkansytorna. Vätskan ges då möjlighet att dräneras via kanaler varpå friktionsgreppet mellan samverkansytorna återupprättas inom ca 1 minut. Vridmomentgränsen kan väljas inom ett brett område, och kan inställas med en hög noggrannhet, exempelvis  $\pm 10\%$  från önskat värde. Kopplingsanordningen har vidare kompakta dimensioner.

15 Ett problem vid den kända anordningen är att den innehållna vätskan/oljan helt eller delvis kan läcka bort innan anordningen utlöses, att oljans egenskaper ändras med tiden, att oljan kan förorenas av partiklar som exempelvis kan bildas i samband med en utlösning och som sätter igen ventiler, silar och stör anordningens funktion, osv.

20 Det finns därför en viss risk för att den kända anordningen felfungerar vid utlösning. En sådan felfunktion skulle då innebära att samverkansytorna inte separeras tillräckligt och att otillräcklig oljemängd pressas in i mellan samverkansytorna. Felfunktionen kan då medföra att mycket höga moment trots allt överföres via anordningen så att exempelvis motorn och driven utrustning skadas, och även så att själva kopplingsanordningen skadas allvarligt. Speciellt med hänsyn till konsekvensen av en sådan felfunktion (jämför stilleståndskostnaden) har den aktuella typen av anordningen inte fått särskilt stor användning i praktiken, trots egenskapen att den vid normal utlösning medger snabb och automatisk återställning och därigenom snabb återupptagning av anläggningens drift efter undanröjande av orsaken till utlösningen.

35 Uppfinningen har till ändamål att anvisa en vidareutveckling av anordningen, för att begränsa effekten av en felfunktion hos anordningen, och sålunda begränsa erforderlig avställningstid



för anläggningen för återställning av anordningen efter fel-funktion vid utlösning på grund av exempelvis otillräcklig oljein-pumpning mellan anordningens samverkansytor.

5      Ändamålet uppnås med en anordning enligt patentkravet 1.

Utföringsformer av anordningen anges i de bilagda osjälvständiga patentkraven.

10      Medan den konventionella anordningens samverkansytor består av lättlegerat kolstål som är nitrerhärdat till ett djup av ca 0,3 mm och har en hårdhet av ca 700 Vickers, anvisas nu enligt uppfinningen att den ena av delarna bär ett ytskikt som definierar den ena av samverkansytorna och som består av ett material med  
15      väsentligt lägre plasticeringsgräns än den andra delens samverkansyta. Ytskiktet kan ha en tjocklek av några millimeter, exempelvis 5 mm och kan såsom ett exempel bestå av en tenn-kopparlegering av typen tombak, dvs exempelvis 90% Cu, 10% Sn, 1% Pb. En sådan legering har en sträckgräns av ca 100 N/m<sup>2</sup>. Ytskiktet  
20      kan vidare ha kaviteter i formen av spår på sin fria yta. Dessa spår kan då bilda vätskefördelningskanaler för lagerfunktionen. Som ett annat alternativ kan ytskiktets kaviteter innehålla andra urtagningar eller håligheter. Syftet med dessa kaviteter i ytskiktet är att säkerställa att ytskiktets material, exempelvis vid smältning ha en volym som är mindre än det utrymme  
25      mellan hylsan och skaftet som ytskiktet ursprungligen upptog. På grund av att plasticeringen syftar till att eliminera kraftöverföringen mellan hylsan och skaftet, bör kaviteterna i ytskiktet dimensioneras för att ta hänsyn till att hylsans innerdiameter minskar då den avlastas och att skaftets ytterdiameter  
30      ökar då skaftet avlastas, så att det tillgängliga utrymmet för ytskiktet minskar. Skiktets material skall alltså företrädesvis ha en nettovolym som är mindre än volymen för utrymmet mellan hylsan och skaftet efter eliminering av den radiella förspänningen dem emellan, och även med hänsyn till temperaturförhållandena vid ytskiktets plasticering eller smältning (dvs motsvarande volymavvikelse för ytskiktet, hylsan och skaftet) så  
35      att hylsan i princip skulle kunna rotera fri från kontakt med

det plasticerade ytskiktet efter en relativ rotation mellan hylsan och skaftet. Härigenom minskas risken för att ytskiktets material tillförs sådan energimängd att det övergår i smält fas vid en relativ rotation mellan kopplingsanordningens båda huvuddelar.

Plasticeringen av ytskiktet medför en successiv sänkning av ytskiktets materialets flytgräns. Tack vare det nämnda ytskiktet kan det överförda vridmomentet begränsas i fallet att den hydrostatiska lagringsfunktionen inte kan upprätthållas. Kraftöverföringen mellan kopplingsanordningens ingående axel och utaxel kan övervakas och brytas med hjälp av yttre medel, exempelvis genom detektering av eventuell hastighetsskillnad mellan kopplingens in- och utgående del, för begränsning av den relativa rotationen mellan delarna.

Tack vare uppfinningen förhindras skador både i driven utrustning och i drivande utrustning, och begränsas även skador i den vridmomentbegränsande anordningen.

Kopplingen kan enkelt renoveras efter en plasticering/smältning av ytskiktet, genom en uppvärmning av ytskiktet och den del (skaftet) på vilken ytskiktet är buret. Genom att ytskiktets material (tombak) har högre värmeutvidgningskoefficient, kommer skiktet att släppa från delens (skaftets) bas och enkelt dras av från skaftet. Ett ersättningsytskikt i formen av en tombakhylsa kan enkelt skjutas in i/över den ifrågavarande delen (10, 20) och fästas vid denna genom exempelvis ett limförband som destrueras vid renoveringsuppvärmningen eller i samband med ytskiktets plasticering.

Uppfinningen kommer i det följande att beskrivas i exempelform med hänvisning till den bilagda ritningen.

Fig 1 visar schematiskt en axialektion som en vridmomentbegränsande kopplingsanordning.

Anordningen enligt fig 1 är i grunden baserad på anordningen enligt WO 90/00231, vars lärdomar härmed inkorporeras häri.

Kopplingen innefattar i grunden en cylindrisk axeltapp 10 och en tappen/skaftet 10 omslutande hylsa 20, varvid skaftet 10 och hylsan 20 har flänsanslutningar 11 resp. 21 för inkoppling i ett drivningssystem, exempelvis en stor elmotor och en vals tillhörande ett stålvalsverk. Hylsan 20 har en inneryta 22 som samverkar med en ytteryta 12 på skaftet 10. I hylsans vägg finns en oljekammare A som kan trycksättas genom inpumpning av olja med ett tryck, exempelvis i området 0-50 mPa, för frambringning av ett friktionsgrepp i gränsen B mellan samverkansytorna 12, 22. Friktionsgreppet och det maximalt överförbara vridmomentet bestäms av oljetrycket i kammaren A. Efter inpumpning av olja till kammaren A via en fyllningskanal stängs en (icke visad) ventil i kanalen (ej visad).

I den cylindriska delen 20 finns ett nav 30 som är rotationslagrat koaxiellt till delen 20. Navet 30 bär på sin utsida ett lager 5 excentriskt till navets 30 axel. Ett antal oljepumpar 3 arbetar radiellt mellan lagret 5 och en inneryta av delen 5. Pumparna har tillhörande kanaler 4 för pumpning av olja till gränsytan B, exempelvis till dess längdmittområde. Oljan sprider sig längs gränsytan och kan exempelvis samlas upp via en kanal 41 vid gränsytan B ena ände för återföring till pumputrymmet. En oljemängd kan finnas innestängd i pumputrymmet för att direkt sugas av respektive pump och tryckas ut till gränsytan B vid en relativ rotation mellan delarna 10, 20. Vid sådan relativ rotation kommer pumparna 5 att sättas i arbete tack vare excentriciteten för navets 30 ytteryta (lagrets 5 excentriska läge relativt delarna 10, 20). Tappens 10 med hylsan 20 samverkande del har ett ytskikt 50 av tombak (90% Cu, 10% Sn, 1% Pb). Skiktet 50 har spår 51 på sin fria huvudyta. Spåren 51 kan även utnyttjas som oljefördelningsspår för olja från pumparna 3. Oljan från pumpen 3 pumpas via kanalen 40 till gränsytan B längdmittområde och strömmar därifrån axiellt till gränsytan B båda ändar, såsom visas med pilarna. Ett oljeflöde överföres

direkt till pumpkammaren, utan att oljedelflöde uppsamlas via ledningen 41, som sträcker sig tillbaka till oljepumpkammaren.

5 Mellan skaftet 10 och hylsan 20 finns ett utrymme som är helt fyllt av skiktet 50, med undantag för skiktets 50 spår 51. Spåren 51 tjänar även till att emotta delar av skiktet 50 som plasticeras vid relativ rotation mellan delarna 10, 20. Delens 20 yta 22 består av stål och samverkar med skiktets 50 tombak-yta. Tombakskiktet 50 förmår vid normala vridmoment överföra  
10 vridmomentet. Men då vridmomentlasten överstiger det förinställda värdet kommer stålytan 22 att börja glida relativt tombakskiktet 50. Friktionsvärmets och/eller relativrörelsen medför att skiktet 50 snabbt deformeras genom plasticering eller smältning. Tack vare spåren 51 kan skiktets 50 materialyta för-  
15 skjutas radiellt i riktning bort från ytan 22. Skiktets nettovolym bör lämpligen få plats i utrymmet mellan hylsan och skaftet efter det att dessa har avlastats radiellt, och med hänsyn till det deformerade ytskiktets tillstånd och temperatur. Härigenom minskas risken för att materialet 50 tillförs sådan energimängd att det övergår i smält fas. Plasticeringen medför en  
20 successiv sänkning av materialets flytgräns. Materialet 50 går vanligen inte över i smält fas. Tack vare plasticeringen av materialet 50 och dess deplacering begränsas effektöverföringen mellan delarna 10, 20 om pumparna 3 inte förmår pumpa in olja i  
25 gränsytan B.

Friktionsingreppet mellan skaftet och hylsan kan givetvis etableras med andra medel än den i fig 1 illustrerade trycksättningen av hydraulkammaren A. Exempelvis kan hylsan och skaftet  
30 vara koniska och kan de axiellt drivas samman för uppnående av ett valt friktionsgrepp, dvs en vald övre momentöverföringsgräns. Om hylsan och skaftet har i förväg valda dimensioner för ett visst friktionsingrepp, kan ingreppet åstadkommas genom s.k. värmekrympning eller genom att hylsan påpressas på skaftet.  
35 När friktionsingreppet elimineras, dvs då den radiella förspänningen mellan skaftet och hylsan undanröjes, kommer skaftets ytterdiameter att öka och hylsans innerdiameter att

minskas. Ytskiktet bör därför vara dimensionerat så att dess nettovolym helst med viss marginal får plats i utrymmet mellan hylsan och skaftet när friktionsförbandet har eliminerats, dvs när hylsan och skaftet har radiellt avlastats. Genom att för ytskiktet 50 välja ett material med en relativt låg plasticeringsgräns, kan man sålunda uppnå att en begynnande rotation mellan delarna 10, 20 i frånvaro av en oljehinna mellan dem kan utlösas vid en relativt låg vridmomentgräns, som dock ligger över den vridmomentgräns vilken etableras av friktionsingreppet mellan delarna 10, 20, tack vare den begynnande plasticeringen av ytskiktets material. Materialet 50 kan på sätt och vis sägas bilda ett glidmedel i gränssytan mellan skaftet och hylsan. Genom att säkerställa att ytskiktet får plats i den resulterande spalten mellan hylsan och skaftet efter deras radiella avlastning, minimeras överföringen av energi till skiktets 50 material och minskas energiöverföringen mellan skaftet och hylsan.

För att ytskiktet å ena sidan initialt skall kunna överföra energi mellan de båda delarna och å andra sidan kollapsa och inta ett tillstånd med avsevärt mindre radiell tjocklek, kan ytskiktet förutom de funktionella spåren på sin fria yta även innehålla andra urtagningar eller håligheter, exempelvis porer eller dylikt, i sitt initiala tillstånd.

**P a t e n t k r a v**

1. Vridmomentbegränsande kopplingsanordning, innefattande  
5 två koaxiella väsentligen cylindriska samverkansytor (12, 22) på  
två samverkande delar (10, 20) i formen av en cylindrisk hylsa  
(20) respektive ett cylindriskt skaft (10), varvid hylsan står  
i ett friktionsingrepp med skaftet för överföring av vridmoment  
10 upp till en mot friktionsingreppet motsvarande gräns, vid vil-  
ken hylsan börjar rotera relativt skaftet, och åtminstone en  
pumpanordning (3) som är anordnad att vid relativ rotation mel-  
lan hylsan och skaftet drivas för pumpning av en vätska från  
ett förråd till en spalt (B) mellan samverkansytorna (12, 22),  
varvid medel (41) är tillhandahållna för att bortleda vätskan  
15 från spalten (B) för återställning av friktionsingreppet efter  
ett överskridande av vridmomentgränsen, **kännetecknad av** att den  
ena delen (10) innefattar en bas med ett ytskikt (50) vilket  
definierar den ena (12) av samverkansytorna och vilket består  
av ett material med väsentligt lägre plasticeringsgräns än ma-  
20 terialet i den andra delens (20) samverkansyta (22).
2. Anordning enligt krav 1, **kännetecknad av** att ytskiktet  
(50) har kaviteter (51) för att vid plasticering kunna fjärras  
från den andra delens samverkansyta (22).
- 25 3. Anordning enligt krav 2, **kännetecknad av** att kaviteter-  
na består av spår (50) som är riktade runt omkretsen och som är  
belägna på ytskiktets samverkansyta.
- 30 4. Anordning enligt något av kraven 1-3, **kännetecknad av**  
att ytskiktet (50) består av tombak och att den andra delens  
samverkansyta består av stål.
5. Anordning enligt något av kraven 1-4, **kännetecknad av**  
35 att delarna (10, 20) är inbördes radiellt förspända för etable-  
ring av det nämnda friktionsingreppet.

6. Anordning enligt något av kraven 1-5, **kännetecknad av** att ytskiktet (50) har kaviteter för att medge ytskiktet att inta en radiell tjocklek som är mindre än det radiella avståndet mellan basens yta och den andra delens (20) samverkansyta (22) efter en plasticering och/eller smältning av ytskiktet (50) och en radiell avlastning av delarna (10, 20).

7. Anordning enligt något av kraven 1-6, **kännetecknad av** att ytskiktet består av ett material med högre värmeutvidgningskoefficient än basens värmeutvidgningskoefficient.

**S a m m a n d r a g**

En vridmomentbegränsande kopplingsanordning innefattar två ko-  
5 axiella väsentligen cylindriska samverkansytor (12, 22) på två  
samverkande delar (10, 20) i formen av en cylindrisk hylsa (20)  
respektive ett cylindriskt skaft (10), varvid hylsan och skaf-  
tet står i radiellt förspänt friktionsingrepp för överföring av  
vridmoment upp till den mot den radiella förspänningen svarande  
10 momentgräns, vid vilken hylsan börjar rotera relativt skaftet,  
och varvid anordningen innefattar åtminstone en pumpanordning  
(3) som är anordnad att vid relativ rotation mellan hylsan och  
skaftet drivas för pumpning av en vätska från ett förråd till  
en spalt (B) mellan samverkansytorna (12, 22), varvid medel är  
15 tillhandahållna för att bortleda vätskan från spalten (B) för  
återställning av friktionsingreppet efter en inträffad relativ  
rotation mellan delarna. Den ena delen (10) har en bas som är  
försedd med ett ytskikt (50) vilket definierar den ena (12) av  
samverkansytorna och som består av ett material, exempelvis  
20 tombak, med väsentligt lägre plasticeringsgräns än materialet i  
den andra delens (20) samverkansyta. Ytskiktet (50) har kavite-  
ter så att det efter plasticering kan inta en mindre radiell  
tjocklek för att medge radiell avlastning av delarna (10, 20).



REC'D 01 NOV 2001

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P7853PC	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/SE00/02101	International filing date (day/month/year) 27.10.2000	Priority date (day/month/year) 29.10.1999
International Patent Classification (IPC) or national classification and IPC7 F16D 43/21, F16D 9/00		
Applicant Curt Falk AB et al		

<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of <u>3</u> sheets, including this cover sheet.</p> <p><input type="checkbox"/> This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of _____ sheets.</p>
<p>3. This report contains indications relating to the following items:</p> <p>I <input checked="" type="checkbox"/> Basis of the report</p> <p>II <input type="checkbox"/> Priority</p> <p>III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p>IV <input type="checkbox"/> Lack of unity of invention</p> <p>V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p>VI <input type="checkbox"/> Certain documents cited</p> <p>VII <input type="checkbox"/> Certain defects in the international application</p> <p>VIII <input type="checkbox"/> Certain observations on the international application</p>

Date of submission of the demand 22.05.2001	Date of completion of this report 01.10.2001
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 08-667 72 88	Authorized officer Jan-Axel Ylivainio / MRo Telephone No. 08-782 25 00

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/SE00/02101

**I. Basis of the report****1. With regard to the elements of the international application:\***

- ☒ the international application as originally filed
- ☐ the description:  
pages \_\_\_\_\_, as originally filed  
pages \_\_\_\_\_, filed with the demand  
pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_
- ☐ the claims:  
pages \_\_\_\_\_, as originally filed  
pages \_\_\_\_\_, as amended (together with any statement) under article 19  
pages \_\_\_\_\_, filed with the demand  
pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_
- ☐ the drawings:  
pages \_\_\_\_\_, as originally filed  
pages \_\_\_\_\_, filed with the demand  
pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_
- ☐ the sequence listing part of the description:  
pages \_\_\_\_\_, as originally filed  
pages \_\_\_\_\_, filed with the demand  
pages \_\_\_\_\_, filed with the letter of \_\_\_\_\_

**2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.**These elements were available or furnished to this Authority in the following language English which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☒ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

**3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:**

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

**4. ☐ The amendments have resulted in the cancellation of:**

- ☐ the description, pages \_\_\_\_\_
- ☐ the claims, Nos. \_\_\_\_\_
- ☐ the drawings, sheet/fig \_\_\_\_\_

**5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2 (c)).\*\***

\* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

\*\* Any replacement sheet containing such amendments must be referred to under item I and annexed to this report.

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/SE00/02101

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement****1. Statement**

Novelty (N)	Claims	<u>1-7</u>	YES
	Claims		NO
Inventive step (IS)	Claims	<u>1-7</u>	YES
	Claims		NO
Industrial applicability (IA)	Claims	<u>1-7</u>	YES
	Claims		NO

**2. Citations and explanations (Rule 70.7)**

## Cited documents:

1. WO 9000231 A1
2. US 2447384 A
3. GB 2268569 A
4. US 4341484 A

The documents cited in the International Search Report represent background art.

The invention defined in claims 1-7 is not disclosed by any of these documents.

None of the cited documents gives any indication towards the claimed torque-limiting coupling device. No relevant combination of the cited documents would lead a person skilled in the art to the invention defined in the claims.

Therefore, the invention defined in claims 1-7 is novel and is considered to involve an inventive step. It is also considered to be industrially applicable.

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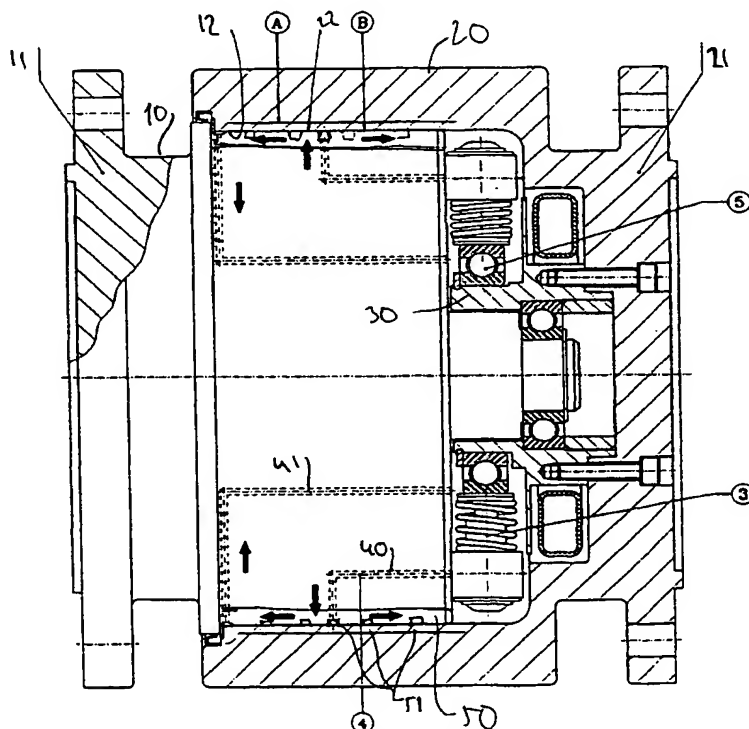
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**Published:**

— With international search report.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: A TORQUE-LIMITING COUPLING DEVICE



(57) Abstract: A torque-limiting coupling device comprises two coaxial, essentially cylindrical co-acting surface (12, 22) on two co-acting parts (10, 20) in the form of a cylindrical sleeve (20) and a cylindrical shaft (10) respectively. The sleeve and the shaft are in radially tensioned frictional engagement for transferring torque up to a torque limit that corresponds to the radial tension and at which the sleeve begins to rotate relative to the shaft. The device also includes at least one pump means (3) which is adapted to be driven to pump liquid from a liquid store to a gap (B) between the co-acting surfaces (12, 22) upon relative rotation between the sleeve and the shaft. Means (8) are provided for leading liquid away from the gap (8) so as to re-establish said frictional grip subsequent to the occurrence of relative rotation between said parts. One part (10) has a base which includes a surface layer (50) that defines one (12) of the co-acting surfaces and that is comprised of a material, e.g. tombak, whose plasticizing limit is considerably lower than the plasticizing limit of the material in the co-acting surface of the other part (20). The surface layer (50) includes cavities which enable the surface layer (50) to take a smaller

radial thickness after plasticization to enable the parts (10, 20) to be relieved of radial load.

WO 01/31219 A1

## A TORQUE-LIMITING COUPLING DEVICE

The present invention relates to a torque-limiting coupling device of the kind defined in the preamble of Claim 1.

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A coupling device of the kind in question is disclosed in WO 90/00231. This known device generally functions well. Devices of this kind are often used in steel rolling mills between a drive motor, for instance an electric motor, and a roll. The power transferred may be in the order of 20,000 kW. Idling costs in respect of such a rolling mill may lie in the order of up to 100,000 SEK/hour.

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In the case of the areas of use concerned, the device is triggered with a relatively low frequency, for instance a frequency in the region of once every five years to 300 annually. A typical activating frequency is twenty times per annum.

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Basically, the coupling device comprises two axially, generally cylindrical interacting surfaces on two interacting parts in the form of a cylindrical sleeve and a cylindrical shaft respectively, wherein the sleeve is in a torque-transmitting frictional contact with the shaft for transmission of torque up to a corresponding limit, after which the sleeve begins to slide or slip relative to the shaft. The frictional engagement can be adjusted to a selective level with the aid of some suitable technique. For instance, the sleeve may include a concentric ring-chamber that can be placed under pressure. The coupling device includes one or more pumps that function to pump liquid from a liquid store to the gap between the interacting surfaces, such that the liquid will form a hydrostatic layer together with said interacting surfaces. The pumps are intended to be driven by relative rotation between said parts. As a result of pumping liquid in between the mutually co-acting surfaces, said surfaces are able to slide relative to one another immediately the set torque is exceeded. This enables damage to the coupling device and to the motor or rolling mill to be avoided. A torque-limiting coupling device of this known kind need only rotate through barely one revolution in order to generate an hydrostatic layer for which the torque is reduced to a level close to zero.

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When the device is triggered, it is necessary to stop the drive completely. The pumps in the coupling device will then stop pumping liquid (oil) in between the mutually interacting

surfaces. This enables the liquid to drain away through channels, wherewith the frictional engagement between said mutually interacting surfaces is re-established within the space of about 1 minute. The torque limit can be chosen within a wide range, and can be set with a high degree of accuracy, for instance  $\pm 10\%$  from a desired value. The coupling device also has compact dimensions.

Problems associated with this known device reside in the possibility of all or part of the liquid/oil contained in the device leaking away before the device is triggered, or caused by a change in the properties of the oil with time, contamination of the oil with particles that can be formed, for instance, in conjunction with triggering the device and that clog valves, filters, and disturb or interfere with the function of the device, and so on.

There is therefore a certain risk that this known device will malfunction when triggered. Malfunctioning of the device would mean that the mutually interacting surfaces would not be separated sufficiently and that insufficient oil would be pressed in between the interacting surfaces. The malfunction may then cause a very high torque to be transferred via the device in spite of everything else, therewith resulting in damage to the motor and driven equipment for instance, and also such as to cause serious damage to the coupling device itself. Particularly with a view to the consequence of such a malfunction (compare the idling cost), the type of device concerned has not found particularly wide use in practice, despite the ability of the device to enable automatic and fast resetting with normal triggering of the device, and thereby a fast return to plant operation after having removed or rectified the triggering cause.

An object of the invention is to provide a further development of the device for limiting the effect of a device malfunction, and thus limit the temporary shutdown time required for the arrangement to reset the device subsequent to a malfunction occurring when the device is triggered as a result, for instance, of insufficient oil being pumped in between the mutually interacting surfaces of the device.

This object is achieved with a device according to Claim 1.

Further embodiments of the device will be apparent from the accompanying dependent Claims.

Whereas the interacting surfaces of the conventional device are comprised of lightly alloyed carbon steel that has been nitrogen case hardened to a depth of about 0.3 mm and has a hardness of about 700 Vickers, it is now proposed in accordance with the invention that one of said parts carries a surface layer which defines one of the interacting surfaces and which is comprised of a material that has a substantially lower plasticizing limit than the interacting surface of the other part. The surface layer may have a thickness of some millimetres, for instance 5 mm, and may, for instance, be comprised of a tin-copper alloy of the tombak kind, i.e. 90% Cu, 10% Sn, 1% Pb, for instance. Such an alloy has an elastic limit of about 100 N/m<sup>2</sup>. The surface layer may also include cavities in the form of grooves on its free surface. These grooves are able to form liquid distribution channels for the bearing function. Alternatively, the cavities in the outer layer may contain other recesses or hollows. The reason for these cavities in the surface layer is to ensure that the surface layer material, for instance when melting, has a volume that is smaller than the space between sleeve and shaft originally occupied by the surface layer. Because the plasticization is meant to eliminate the transmission of power between sleeve and shaft, the cavities in the surface layer will preferably be dimensioned to take into account the fact that the inner diameter of the sleeve decreases when relieved of load, and that the outer diameter of the shaft increases when the load on the shaft is removed, such that the space available for the surface layer will decrease. The layer material shall thus preferably have a net volume that is smaller than the volume for the space between sleeve and shaft after eliminating the radial stress therebetween, and also with respect to the temperature conditions when plasticizing or melting the surface layer (i.e. corresponding volume deviations in respect of the surface layer, the sleeve and the shaft) so that the sleeve is able in principle to rotate free from contact with the plasticized surface layer subsequent to relative rotation between the sleeve and the shaft. This reduces the risk of the surface layer material being supplied with energy in such quantities as to cause the material to melt as a result of relative rotation between the two main parts of the coupling device.

Plasticization of the surface layer causes successive reduction in the liquid limit or yield stress of the surface layer material. This surface layer enables the torque that is transferred when the hydrostatic bearing function cannot be maintained to be limited. The power transmission between the input shaft of the coupling device and its output shaft can be monitored and stopped with the aid of external means, for instance by detecting a possible

difference in the speed between the input and output parts of the device, for limiting the relative rotation between said parts.

The invention is effective in preventing damage to the driven equipment and also to the driving equipment, and also limits damage to the torque-limiting device.

The coupling can be readily renovated subsequent to plasticization (melting of the surface layer), by heating said layer and that part (the shaft) that carries the surface layer. Because the surface layer is comprised of material (tombak) that has a high coefficient of thermal expansion, the layer will loosen from the base of said part (the shaft) and easily drawn off the shaft. A replacement surface layer in the form of a tombak-sleeve can be simply inserted into/pushed over the part concerned (10, 20) and fastened thereto by means of a glue joint, for instance, this joint being destroyed by the heat applied in the renovating process or in conjunction with plasticization of the surface layer.

The invention will now be described by way of example with reference to the accompanying drawing.

Fig. 1 is a schematic axial sectioned view of a torque-limiting coupling device.

The device illustrated in Figure 1 is based fundamentally on the device according to WO 90/00231, the teachings of which are incorporated in this document.

The coupling device basically comprises a cylindrical trunnion 10 and a sleeve 20 that embraces the trunnion/shaft 10, said shaft 10 and sleeve 20 have respective flange connections 11 and 21 for connecting up a drive system, for instance a large electric motor and a roll belonging to a steel rolling mill. The sleeve 20 has an inner surface 22 that co-acts with an outer surface 12 on the shaft 10. There is included in the sleeve wall an oil chamber A that can be placed under pressure by pumping-in oil at a pressure, e.g., in the range of 0-50 mPa, to cause frictional engagement at the interface B between the mutually co-acting surfaces 12, 22. The frictional grip and the maximum torque that can be transferred are determined by the oil pressure in the chamber A. After pumping oil into the chamber A via a filling channel, a valve (not shown) in the channel (not shown) is closed.



The cylindrical part 20 includes a hub 30 which is mounted for rotation co-axially with the part 20. The hub 30 carries on its outside a bearing 5 which is eccentric with respect to the hub axle. A number of oil pumps 3 operate radially between the bearing 5 and an inner surface of said part. The pumps have associated channels 4 through which oil is pumped to the interface B, for instance to its longitudinal centre region. The oil spreads along the interface and can, for instance, be collected-up via a channel 41 at one end of the interface B and returned to the pump space. A quantity of oil may be enclosed internally in the pump space, so as to be sucked up by respective pumps immediately and pressed out to the interface B upon relative rotation between the parts 10, 20. The pumps 5 will be set into operation upon such relative rotation, owing to the eccentricity of the outer surface of the hub 30 (the eccentric position of the bearing 5 relative to the parts 10, 20). The part of the shaft 10 that co-acts with the sleeve 20 has a surface layer 50 of tombak (90% Cu, 10% Sn, 1% Pb). The layer 50 has grooves 51 in its free main surface. The grooves 51 may also be utilised as oil distributing channels for distributing oil from the pumps 3. Oil is pumped from the pump 3 to the longitudinal centre region of the interface B, via the channel 40, and flows from there axially to both ends of the interface B, as shown by the arrows in the Figure. A flow of oil is transferred directly to the pump chamber, and an oil part-flow is collected via the channel 41 extending back to the oil pump chamber.

There is located between the shaft 10 and the sleeve 20 a space which is filled completely by the layer 50, with the exception of the grooves 51 in said layer. The grooves 51 also serve to receive parts of the layer 50 that are plasticized as a result of relative rotation between the parts 10, 20. The surface 22 of the part 20 is comprised of steel and co-acts with the tombak surface of the layer 50. The tombak layer 50 is able to transfer the torque at normal torque. However, when the torque load exceeds the pre-set value, the steel surface 22 will begin to slide relative to the tombak layer 50. The friction heat and/or the relative movement causes the layer 50 to deform rapidly, as a result of plasticization or melting. The grooves 51 enable the material in the surface of the layer 50 to be displaced radially in a direction away from the surface 22. The net volume of the layer should be accommodated appropriately in the space between the sleeve and the shaft, subsequent to the sleeve and shaft having been relieved of load in a radial direction and in view of the state and temperature of the deformed surface layer. This reduces the risk of the material 50 receiving so much energy as to cause the material to melt. The plasticization results in a successive reduction in the liquid limit of the material. Normally, the material 50 will not

pass into a molten phase. As a result of plasticization of the material 50 and the displacement of said material, the power transmission between the parts 10, 20 will be limited if the pumps 3 are not able to pump oil into the interface B.

5 The frictional engagement between the shaft and the sleeve can, of course, be established with means other than pressurising the hydraulic chamber A as in the illustrated embodiment. For instance, the sleeve and the shaft may be conical and driven axially together so as to achieve a chosen frictional grip, i.e. a chosen upper torque transmission limit. When the sleeve and the shaft have pre-selected dimensions to achieve a given  
10 frictional grip, the grip can be achieved by so-called heat shrinkage or by press-fitting the sleeve to the shaft. When the frictional grip is eliminated, i.e. when the radial stress between shaft and sleeve is removed, the outer diameter of the shaft will increase and the inner diameter of the sleeve will decrease. The outer layer should therefore be dimensioned so that its net volume can be accommodated, with a given margin, in the space between the  
15 sleeve and the shaft when the friction joint has been eliminated, i.e. when the load on the sleeve and the shaft has been removed radially. Thus, by forming the outer layer 50 with a material that has a relatively low plasticizing limit, it is possible to trigger an initial rotation between the parts 10, 20 in the absence of an oil film therebetween, at a relatively low torque limit that, nevertheless, lies above the torque limit established by the friction  
20 grip between the parts 10, 20 as a result of the initial plasticization of the surface layer material. The material 50 can be said to form a lubricant in the interface between shaft and sleeve. When ensuring that the surface layer can be accommodated in the resultant gap between sleeve and shaft after having relieved the same of load in a radial direction, the transfer of energy to the material of the layer 50 is minimised, as is also the transmission of  
25 energy between the shaft and the sleeve.

In order for the surface layer to be able initially to transfer energy between said two parts, on the one hand, and to collapse and take a state of considerable smaller radial thickness, on the other hand, the outer layer may also include other recesses or hollows additional to  
30 the functional grooves on its free surface, for instance pores or the like, in its initial state.

## CLAIMS

1. A torque-limiting coupling device comprising two coaxial, generally cylindrical co-acting surfaces (12, 22) on two co-acting parts (10, 20) in the form of a cylindrical sleeve (20) and a cylindrical shaft (10) respectively, wherein the sleeve is in frictional engagement with the shaft for transmission of torque up to a limit that corresponds to the frictional engagement and at which the sleeve begins to rotate relative to the shaft, and further comprises at least one pump means (3) which, upon relative rotation between the sleeve and the shaft, is driven to pump liquid from a liquid storage to a gap (B) between the co-acting surfaces (12, 22), wherein means (41) are provided for carrying away liquid from the gap (B) so as to restore the frictional grip after having exceeded the torque limit, **characterised** in that one part (10) includes a base that has a surface layer (50) which defines one (12) of said co-acting surfaces and which is comprised of a material that has a plasticizing limit which is substantially lower than the plasticizing limit of the material in the co-acting surface (22) of the other part (20).

2. A device according to Claim 1, **characterised** in that the surface layer (50) includes cavities (51) which enables said surface layer to move away from the co-acting surface (22) of said other part upon plasticization.

3. A device according to Claim 2, **characterised** in that the cavities consist of grooves (50) disposed around the circumference and located on the co-acting surface of the surface layer.

4. A device according to any one of Claims 1-3, **characterised** in that the surface layer (50) is comprised of tombak; and in that the co-acting surface of the other part is comprised of steel.

5. A device according to any one of Claims 1-4, **characterised** in that said parts (10, 20) are mutually tensioned radially to establish said friction grip.

6. A device according to any one of Claims 1-5, **characterised** in that the surface layer (50) includes cavities which allow the surface layer to take a radial thickness that is smaller than the radial distance between the surface of the base and the co-acting surface (22) of

said other part (20) subsequent to plasticization and/or melting of the surface layer (50) and radially relieving the parts (10, 20) of load.

7. A device according to any one of Claims 1-6, characterised in that the surface layers  
5 are comprised of a material whose coefficient of thermal expansion is higher than the  
coefficient thermal expansion of the base.

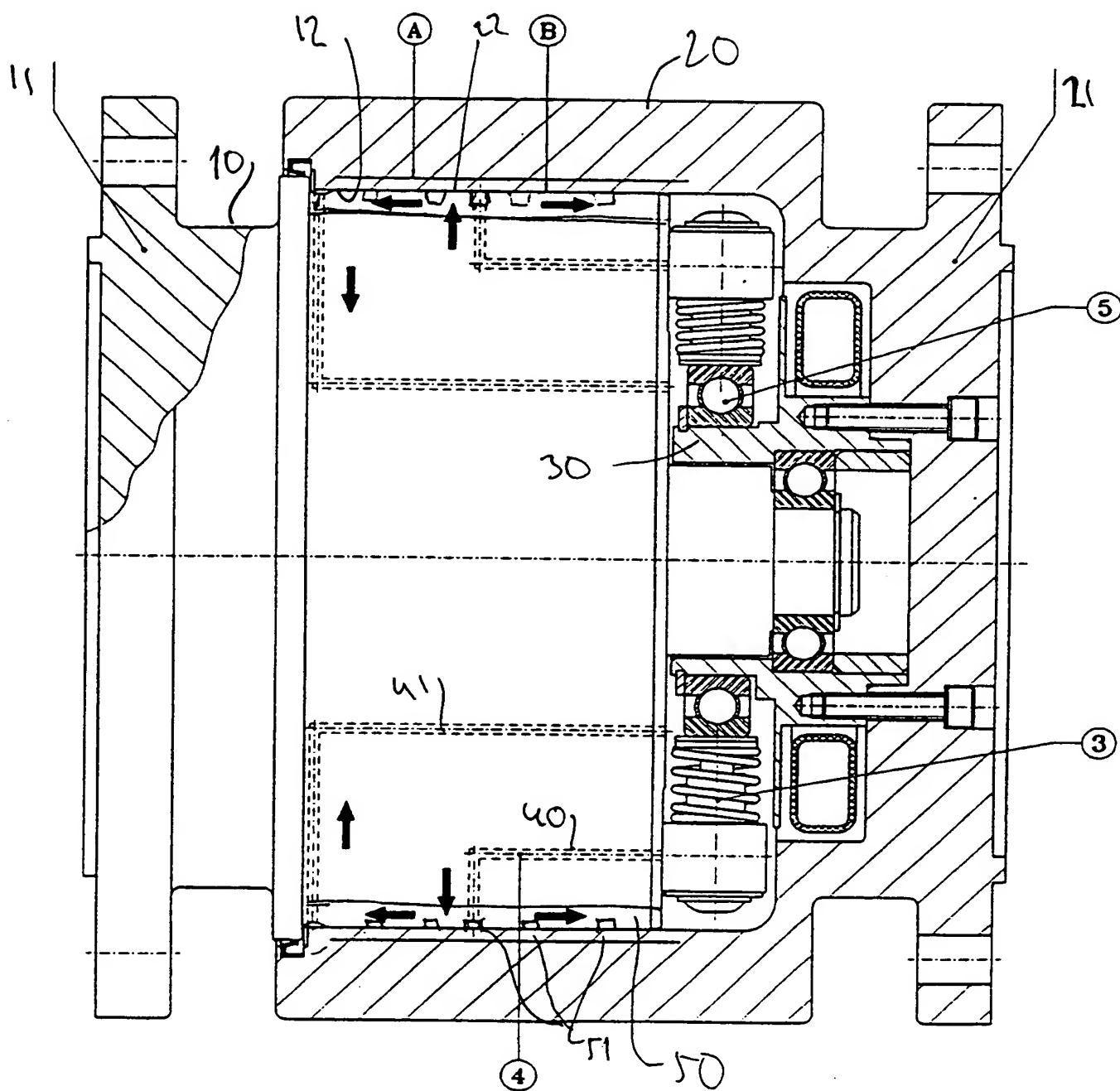


Fig 1.

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 00/02101

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: F16D 43/21, F16D 9/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: F16D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9000231 A1 (METALFORM SAFESET AB), 11 January 1990 (11.01.90), figure 1, abstract  --	1
A	US 2447384 A (O.E. WOLFF), 17 August 1948 (17.08.48), figures 1-9  --	1
A	GB 2268569 A (HORSTMAN DEFENCE SYSTEMS LIMITED), 12 January 1994 (12.01.94), figure 1, abstract  --	1
A	US 4341484 A (PETERSON ET AL), 27 July 1982 (27.07.82), figures 1,2, abstract  --	1

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

\* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
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# INTERNATIONAL SEARCH REPORT

Information on patent family members

27/12/00

International application No.

PCT/SE 00/02101

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